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The first record of the anopsobiid genus *Shikokuobius* Shinohara, 1982 in continental Asia, with the description of a new species from the Altais, southwestern Siberia, Russia (Chilopoda, Lithobiomorpha, Anopsobiidae)

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Abstract

A new lithobiomorph species, *Shikokuobius altaicus* **sp. n.**, is described from the Altai Mountains in southwestern Siberia, Russia. This is the first record of the genus *Shikokuobius* Shinohara, 1982 in continental Asia, all previous reports being from Japan. The distribution of *Shikokuobius* is mapped.

Keywords

Centipede, taxonomy, new species, Altai Mountains, Siberia, Russia

Introduction

The family Anopsobiidae Verhoeff, 1907 is currently known to be represented in the Northern Hemisphere by one small and eight monotypic genera: *Yobius* Chamberlin, 1945 (Utah, USA), *Hedinobius* Verhoeff, 1934 (Tien Shan, western China), *Rhodobius* Silvestri, 1932 (Europe), *Anopsobiella* Attems, 1938 (Vietnam), *Shikokuobius* Shino-

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hara, 1982 (Japan), *Ghilaroviella* Zalesskaja, 1975 (Tajikistan), *Dzhungaria* Farzalieva, Zalesskaja et Edgecombe, 2004 (eastern Kazakhstan), *Speleopsobius* Shear, 2018 (southern Idaho, USA), as well as *Buethobius* Chamberlin, 1911, with 5 species from the USA (Silvestri 1909, Attems 1938, Zalesskaja 1975, Shinohara 1982, Farzalieva et al. 2004, Zapparoli and Edgecombe 2011, Shear 2018).

A collection of lithobiomorph centipedes from the Republic of Altai, Russia, deposited in the Zoological Museum of the Lomonosov Moscow State University, has yielded a single male of a new anopsobiid species of *Shikokuobius*. Four additional specimens of that new species have also been freshly collected from the Altai Province, Russia.

Shikokuobius altaicus sp. n. is very similar to *S. japonicus* (Murakami, 1967) from Japan (Sakuragi, Honshu; Nakameguro and Shirogane; the DNA voucher specimen of Edgecombe and Giribet (2003, 2004), Shizen-Kyoiku-en, Meguro-ku, all in Tokyo). The present paper describes the new species and refines the distribution of the genus *Shikokuobius*.

Material and methods

The material used in the present study was collected by S.I. Golovatch (Moscow, Russia) in the environs of Lake Teletskoye, Republic of Altai and by T.M. Krugova (Barnaul, Russia) with her team of volunteers in the Tigirek State Nature Reserve, Altai Province. Both sites are located in the Russian Altais, southwestern Siberia, Russia. Most of the material is currently deposited in the collection of the Zoological Museum of the Lomonosov Moscow State University, Moscow, Russia (ZMUM), partly also shared with the collection of the Perm State University, Perm, Russia (PSU).

The total body length was measured from the fore margin of the cephalic plate to the posterior end of the postpedal tergite. Leg length was measured excluding the length of the claw. Lengths are given as the minimum and maximum values. All measurements are given in millimeters (mm).

The mouthparts, legs and body segments of the new species were cleared in 10% KOH and mounted in permanent slides in sandarac medium (Krasheninnikov 2011) for examination. The specimens were examined and measured using a Meiji EMZ-5 stereo microscope, and stacks of colour images were manually generated using an Olympus OMD EM-10 digital camera with a Panasonic Lumix H-H025 25 mm f/1.7 lens mounted on a Zeiss microscope. Digital images were prepared using Photoshop CS6 image stacking software. The drawings were executed using a Zeiss microscope and a Zeiss drawing tube. The distribution map was composed using QGIS 3.0.

The terminology of the external anatomy follows Bonato et al. (2010).

The following abbreviations are used in the text:

T, TT	tergite, tergites;	P	prefemur;
C, CC	coxa, coxae;	F	femur.
t	trochanter;		

Results

Taxonomy

***Shikokuobius altaicus* sp. n.**
http://zoobank.org/34A98474-0F2E-41D8-9E7A-A1E84EE30F4C
Figs 1–43, 45

Type material. Holotype ♂ (ZMUM, Rc 7867): Russia, southwestern Siberia, Altai Province, Krasnoshchiokovo District, near Tigirek village, buffer zone of the Tigirek State Nature Reserve, foot of W slope of Mt. Kozyr, 51°09'26.54"N, 83°00'01.59"E, thicket of *Padus avium*, *Lonicera tatarica* and *Viburnum opulus*, 600 m a.s.l., soil sample (30–40 cm deep), 29–30.08.2016, leg. T.M. Krugova, L.Yu. Gruntova, V.V. Zelensky, K.V. Smirnova, A.E. Pupkova, M.N. Terioshkina and R.V. Scherbakova.

Paratypes. 1 ♂ (ZMUM, Rc 7868), 1 ♀ (ZMUM, Rc 7869), together with holotype, soil samples (30–40 cm deep and 0–10 cm deep, respectively); 1 ♀ (PSU-612), Russia, southwestern Siberia, Altai Province, Krasnoshchiokovo District, near Tigirek village, Tigirek State Nature Reserve, Khankhara Site, right bank of Khankhara River, upper part of N slope, 51°11'35.36"N, 82°58'48.26"E, *Larix sibirica* forest with *Betula pendula*, 920 m a.s.l., soil sample (20–30 cm deep), 19.08.2016, leg. T.M. Krugova, L.Yu. Gruntova, V.V. Zelensky, K.V. Smirnova, A.E. Pupkova, M.N. Terioshkina and R.V. Scherbakova.

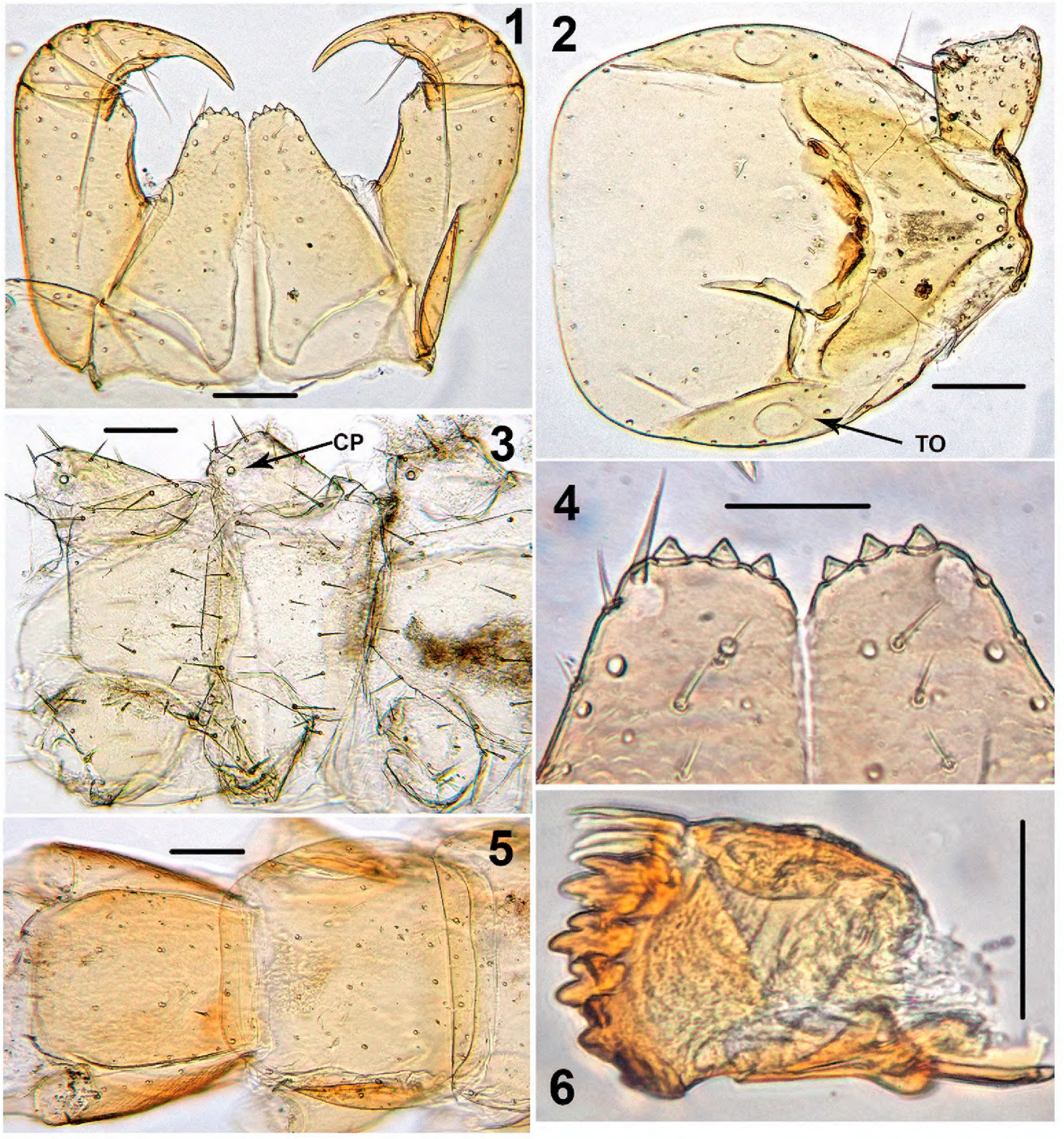
Non-type material. 1 ♂ (PSU-536), [Russia, southwestern Siberia, Republic of Altai, Turochak District], near Lake Teletskoye, environs of Artybash village [51.814745N, 87.278742E, ca 450 m a.s.l.], *Betula pendula*, *Abies sibirica* and *Pinus sibirica* forest, litter, 4–13.07.1982, leg. S.I. Golovatch.

Name. The specific epithet refers to Altai, the *locus typicus*.

Diagnosis. A *Shikokuobius* species with the body 4–6 mm long, the antennae composed of 15–17 antennomeres, commonly 15; coxosternal teeth large, separated from each other by distances less than width at the base of a tooth; P, F and T of 15 leg relatively short and thick, 15 C with a prominent, acute, mesodistal process; the number of coxal pores varying from 1 to 2 on 12–15 CC (formula 1,1,1,1 in the male and 1,1,1,2 in the female); 15 t and 15 P with bifurcate ventral spines (seldom on legs 13 and 14); at least each leg 15 with a bifurcate spine at the distodorsal end of P; 1–10 tibiae with a distal spinose projection (Figs 7–8, 24); 1–12 tarsi clearly unipartite, claws of 1–14 legs with two accessory spines, claw of legs 15 with a single accessory spine; 1st female gonopodal segment with 2+2 coniform spurs and eight long setae, 2nd with four setae, 3rd with a single seta on the external face; terminal claw simple; male gonopod with four segments including terminal filament.

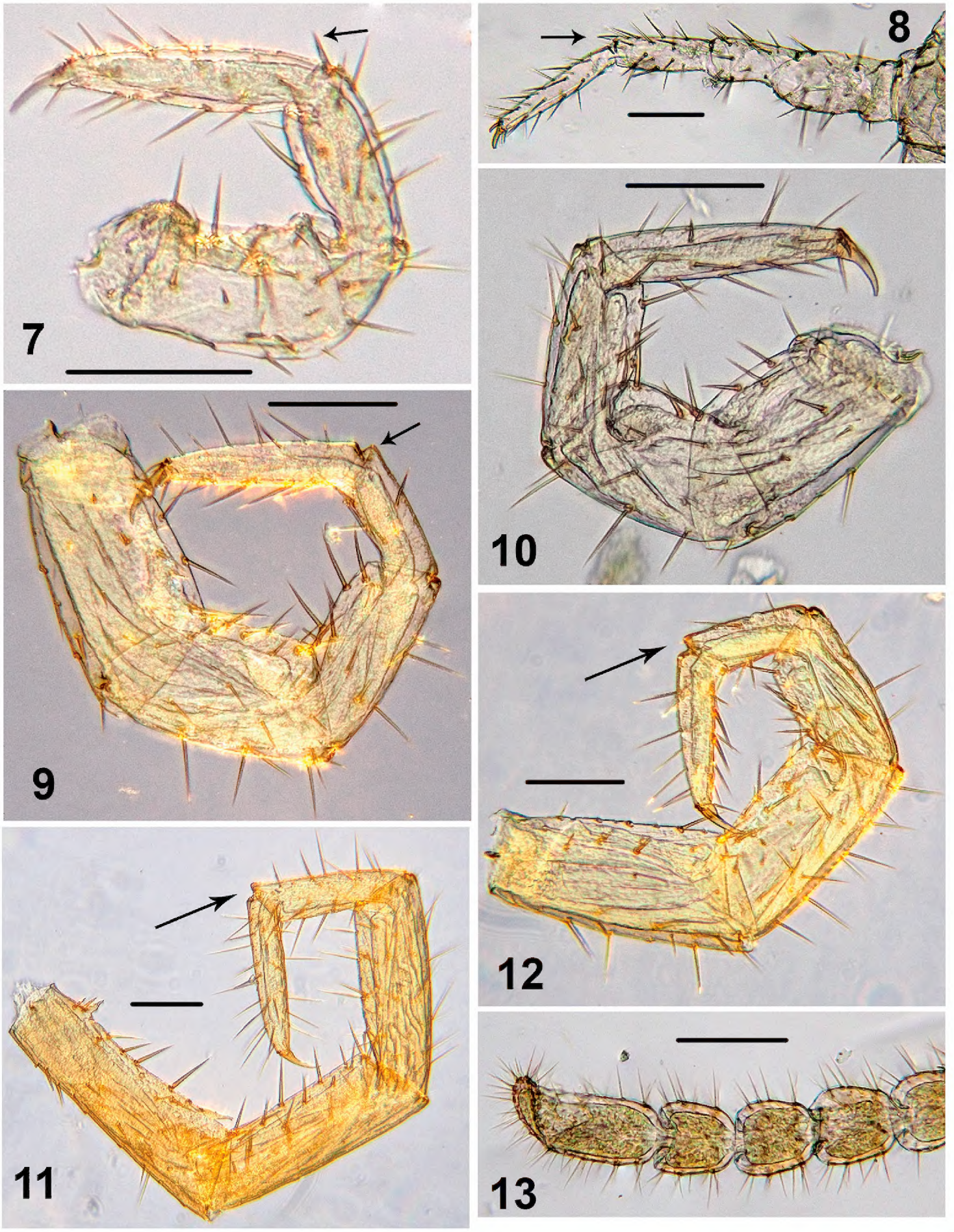
Distribution (Fig. 46). Altai Province and Republic of Altai, southwestern Siberia, Russia.

Description. Holotype ♂. Body ca 4.0 mm long, ca 0.4 mm wide (in 70% alcohol); colour yellow. Tergites: almost smooth, with relatively long and sparse setae, as in Figs 32–33; T 15 indistinct; posterior margin of TT 1, 3, 5, 8, 10, 12 and 14



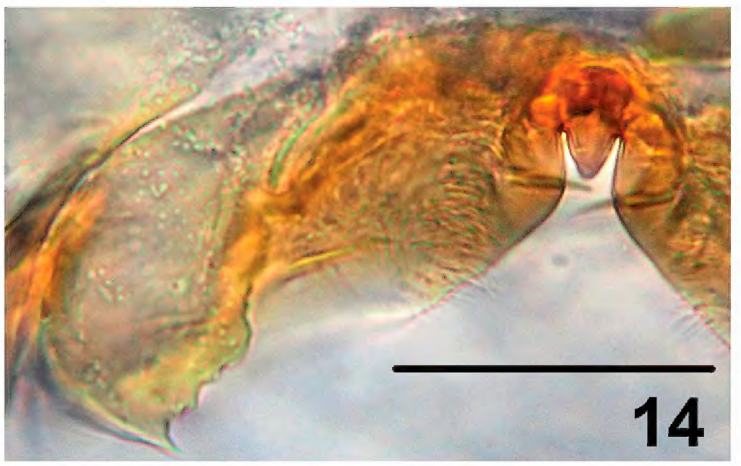
Figures 1–6. *Shikokuobius altaicus* sp. n., male paratype (**1, 3, 6**) and female paratype (**2, 4, 5**). **1** forcipulae, ventral view **2** head, ventral view **3** 12–14 sternites and coxae, ventral view **4** dental margin of forcipular coxosternite **5** 13–16 tergites, dorsal view **6** mandibula, ventrolateral view. Abbreviations: **TO** Tömösváry's organ, **CO** coxal pore. Scale bars: 0.1 mm (**1–5**), 0.05 mm (**6**).

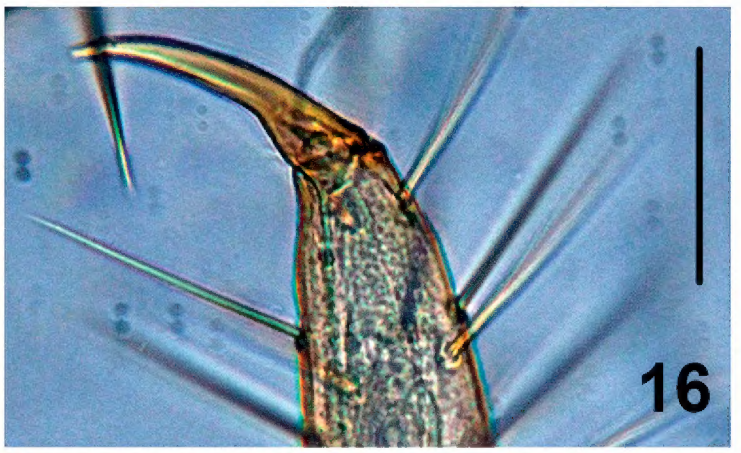
slightly sinuate; TT 2, 4, 6 7 9 11 and 13 almost straight; intermediate T slightly elongated, as in Fig. 5. Cephalic plate: width/length ratio 0.8 (width 0.4 mm, length 0.5 mm). Antennae short, reaching the middle of T3, composed of 15+15 short moniliform articles (Fig. 13). Ocelli absent; Tömösváry's organ very large, oval (Fig. 2). The sides of the labrum with poorly-expressed fringes of bristles; a pair of setae projecting across the labral midpiece present (Figs 14–15). Gnathal edge of mandible with 4 pairs of well-developed teeth and 3–4 rather thick aciculae (Fig. 6). First maxillae: edge with 5–6 plumose bristles and simple setae as well (Figs 28, 36). Sec-

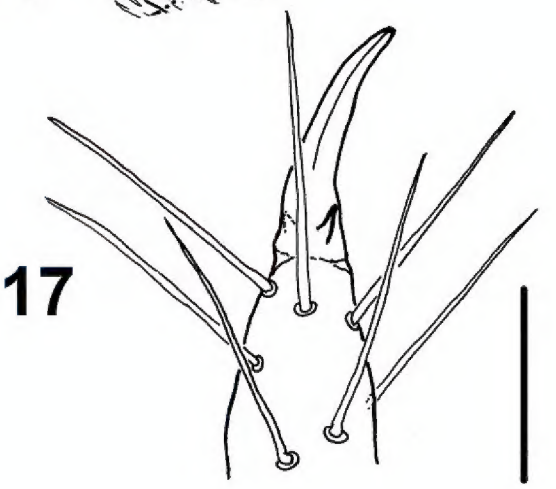


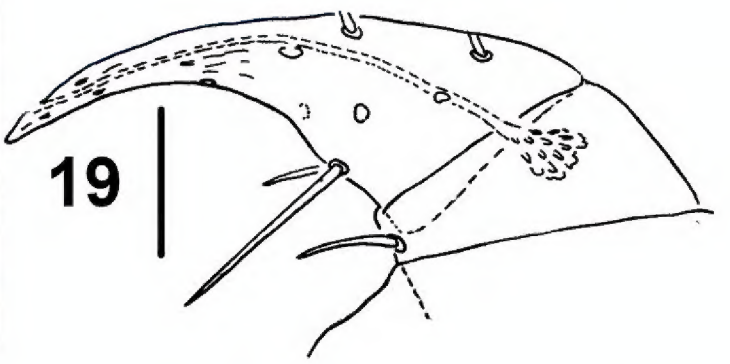
Figures 7–13. *Shikokuobius altaicus* sp. n., male paratype, lateral views. **7** leg 1 **8** leg 3 **9** leg 14 **10** leg 12 **11** leg 15 **12** leg 13 **13** 5 terminal antennomeres. Scale bars: 0.1 mm (**7, 9–13**), 0.5 mm (**8**).

ond maxillary telopodite with simple and plumose bristles on the tip (two plumose bristles on the left and right parts, respectively) (Fig. 20). Forcipulae: dental margin of coxosternite almost straight, with 3+3 teeth and long setiform porodonts, teeth





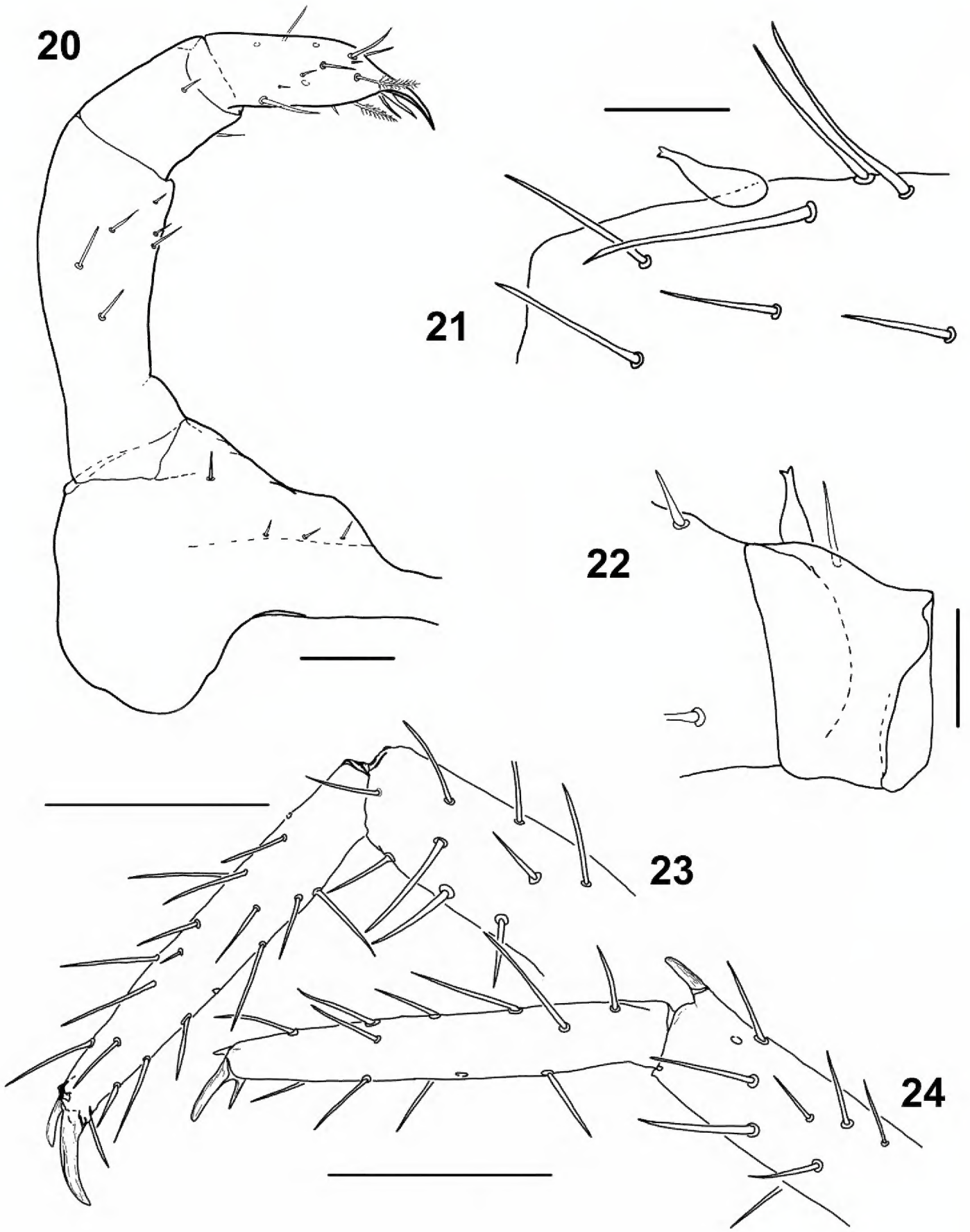




Figures 14–19. *Shikokuobius altaicus* sp. n., male paratype (**14–17**) and female paratypes (**18, 19**). **14, 15** labrum, ventral views **16, 17** apical claw of leg 15, ventrolateral views **18, 19** apical part of forcipular telopodite, ventral views. Scale bar: 0.05 mm.

relatively large, separated from each other by distances less than width at the base of a tooth, median diastema V-shaped; shoulders of coxosternite strongly sloping, as in Figs 1, 4; claw as in Figs 18–19.

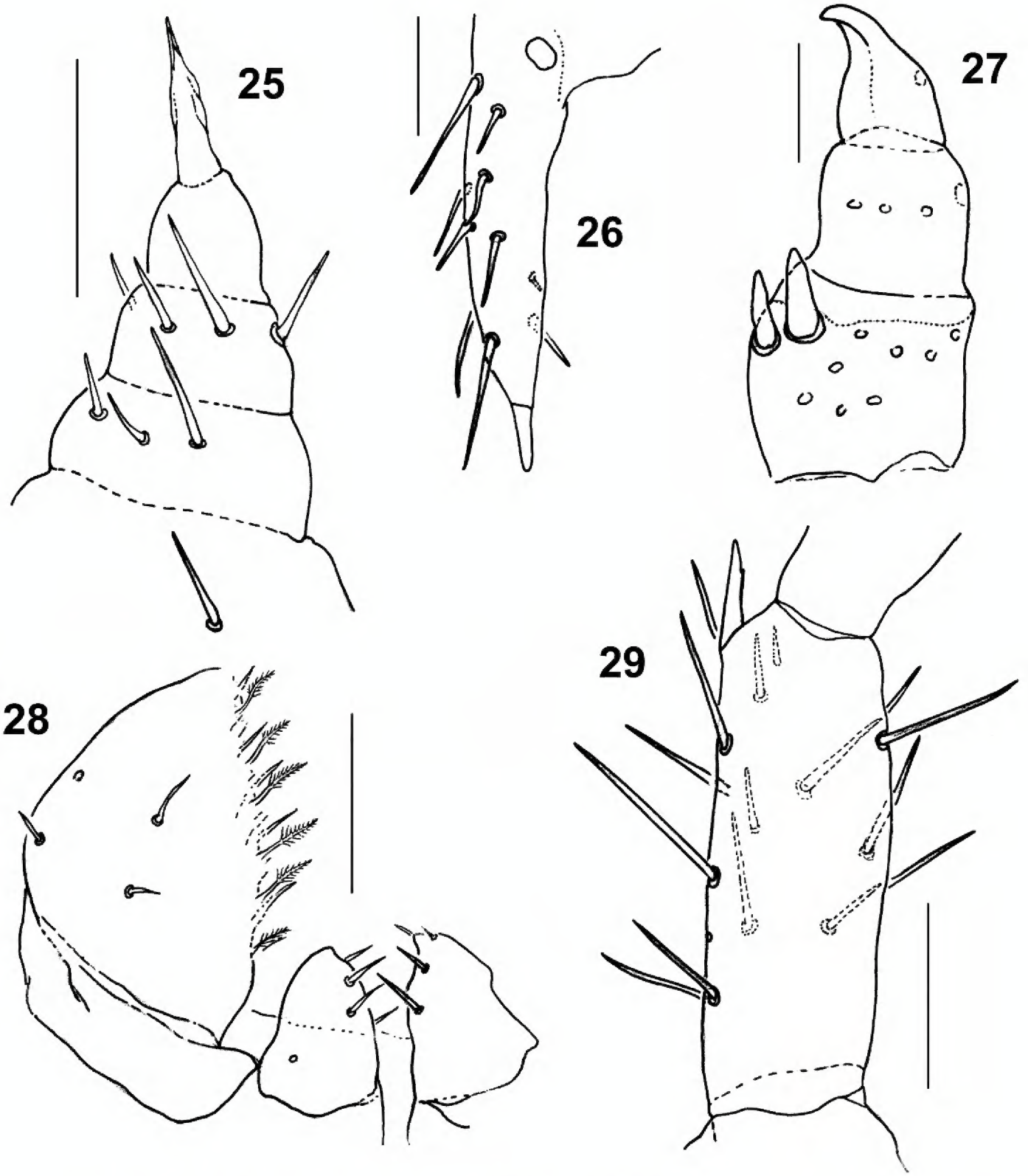
Tarsal articulation of legs 1–12 indistinct, tarsi distinctly longer than tibiae. 1–10 tibiae with a distal spinose projection, as in Figs 7–8, 24. 1–14 legs with two accessory spines. 14 and 15 legs not incrassate, with long setae (Figs 11–12). 15 leg: P, F and T relatively short and thick (Fig. 11); C ventrally with a long process (Fig. 26); t and P ventrally with bifurcate spines (Figs 11, 21–22); tarsus 2 with a small distodorsal projection (Fig. 11, shown by arrow). 14–13 legs with the same, but less strongly expressed distodorsal projections. Accessory spines on 15 leg small, poorly-developed (Figs 16–17). At least 13–15 legs dorsally with trace of a broken spine or process (Figs 9, 11–12). A single coxal pore on each of 12–15 legs small and rounded (Fig. 3). Gonopods 4-segmented including terminal filament; 1st segment with three, 2nd segment with four long setae on the external face (Fig. 25).



Figures 20–24. *Shikokuobius altaicus* sp. n., male holotype (**20–22**) and male paratype (**23, 24**). **20** left part of second maxilla, ventral view **21** ventral spine on prefemur 15, lateral view **22** ventral spine on trochanter 15, lateral view **23** leg 11, lateral view **24** leg 10, lateral view. Scale bars: 0.05 mm (**20–22**), 0.1 mm (**23, 24**).

Paratype ♂. Length 4.0 mm, width 0.4 mm. All other characters as in holotype, but coxal process on leg 15 broken off on both legs.

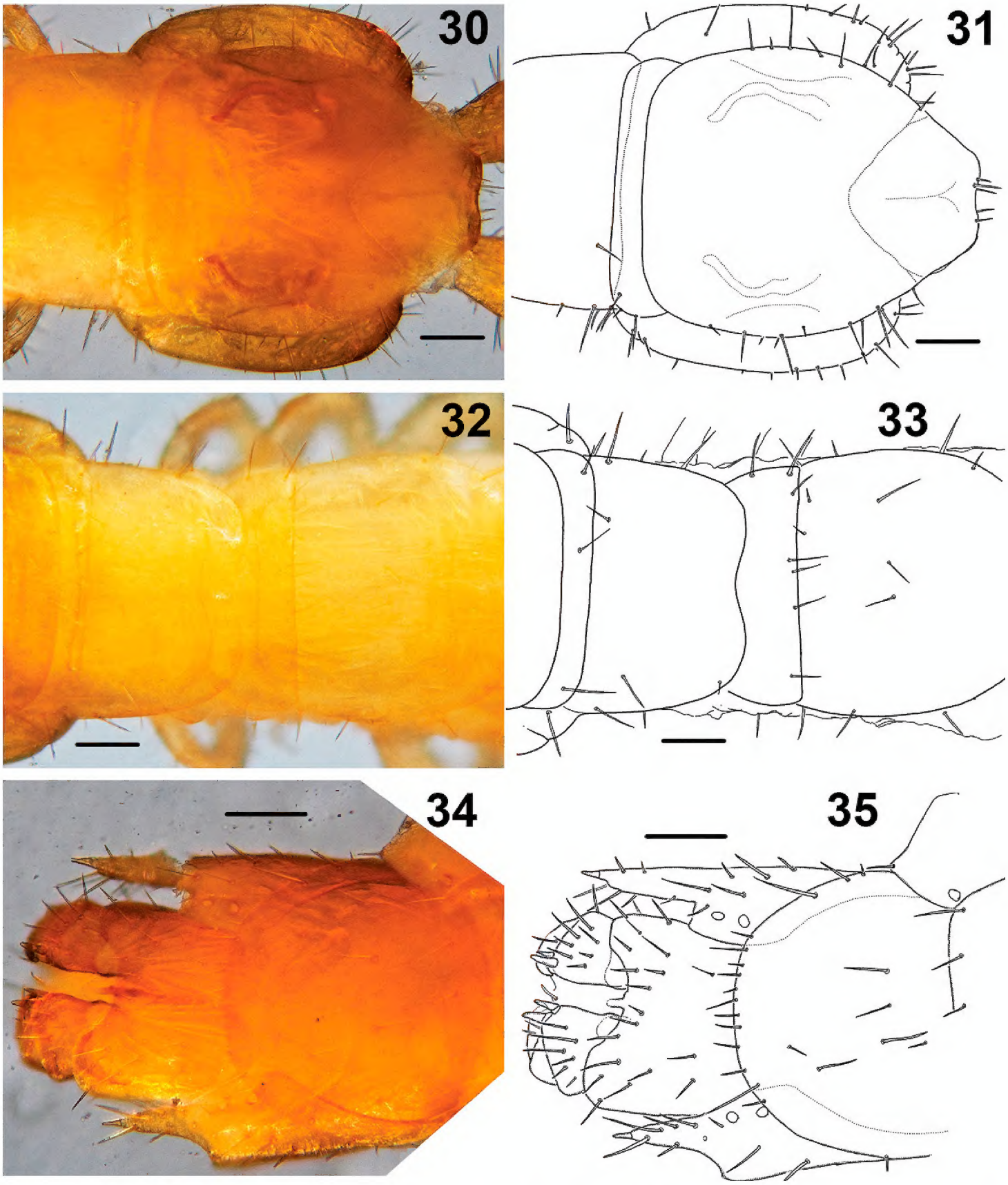
Non-type material ♂. Length 4.9 mm, width 0.5 mm. All other characters as in holotype (Figs 39–40, 42), but antennae with 17+17 articles, first maxillae with at



Figures 25–29. *Shikokuobius altaicus* sp. n., male holotype (**25, 26, 28, 29**) and female paratype (**27**). **25** left gonopod, ventral view **26** left mesodistal process on 15 coxa, ventral view **27** left gonopod, ventral view **28** left part of first maxilla **29** distodorsal process on tibia 3, lateral view. Scale bar: 0.05 mm.

least six plumose bristles (Fig. 37); second maxillae with four plumose bristles; 14 C ventrally with a tiny denticle, as in Fig. 38; 15 P with a bifurcate spine at distodorsal end (Figs 41, 43); 15 leg with a single well-developed accessory spine; 3rd gonopodal segment with two long setae on the external face.

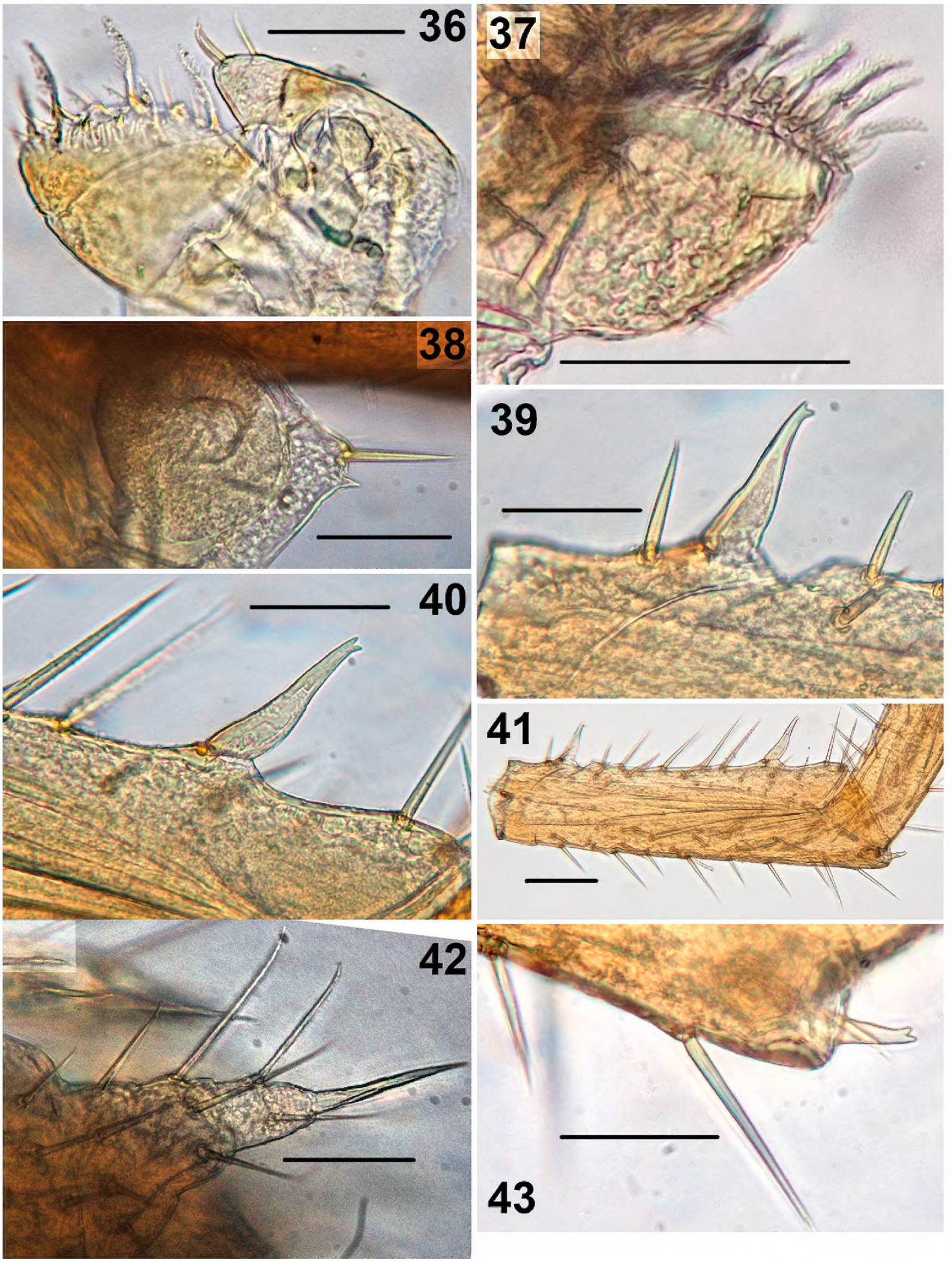
Paratype ♀♀. All characters as in ♂♂. The number of antennomeres in females unknown: one ♀ with antennae completely broken off, while another ♀ with damaged antennae, having 12+7 antennal articles. Coxal pores as in holotype, formula 1,1,1,2 (Figs 34–35). The number of accessory spines unknown: both females had no 15 leg-pairs.



Figures 30–35. *Shikokuobius altaicus* sp. n., female paratype. **30, 31** front body part, dorsal view **32, 33** forcipular and 1–3 leg-bearing segments, dorsal view **34, 35** rear body part, ventral view. Scale bar: 0.1 mm.

Gonopods without setae on internal face, with 2+2 conical spurs and simple claw (Fig. 27). All segments of gonopods with long setae (broken off as in Fig. 27): 1st segment with eight setae, 2nd with four ones, while 3rd with a single seta on the external face of gonopod.

Habitats. The new species was collected in the lowland Altais in small-leaved and mixed taiga forests at 450 to 920 m a.s.l. (Fig. 45), mainly in soil samples, frequently in deep layers down to 40 cm.



Figures 36–43. *Shikokuobius altaicus* sp. n., male paratype (**36**) and not-type male (**37–43**). **36** left part of first maxilla, ventral view **37** right part of first maxilla, ventral view **38** distal part of coxa 15, ventral view **39** spine on trochanter 15, lateral view **40** spine on prefemur 15, lateral view **41** trochanter and prefemur 15, lateral view **42** right gonopod, ventral view **43** distodorsal spine on prefemur 15, lateral view. Scale bars: 0.05 mm (**36–40, 42, 43**), 0.1 mm (**41**).

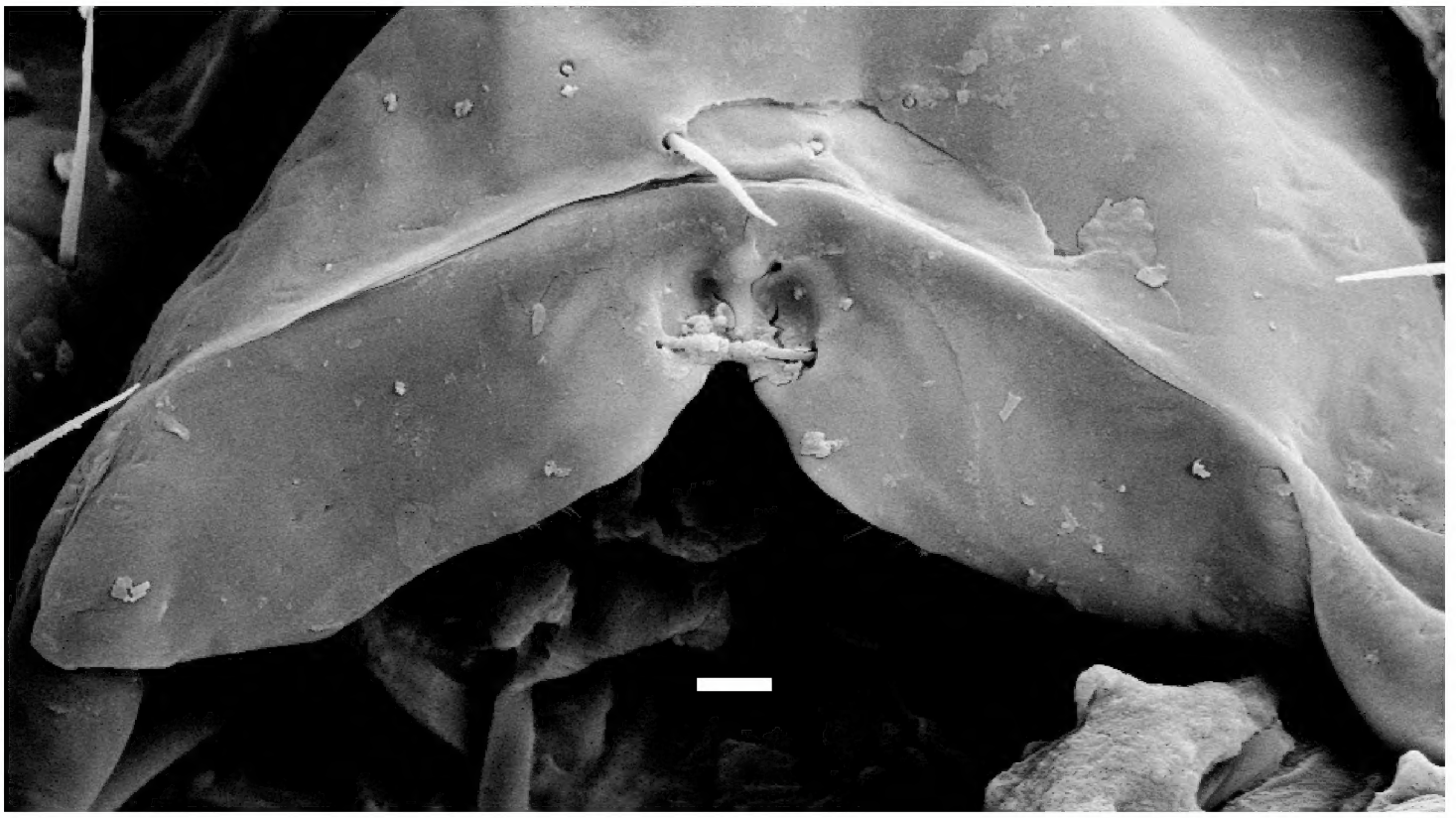
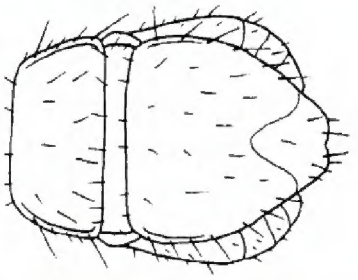
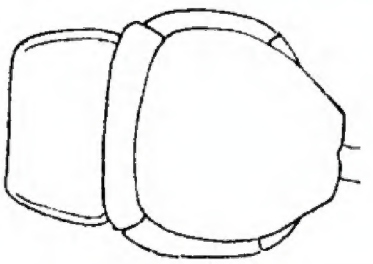
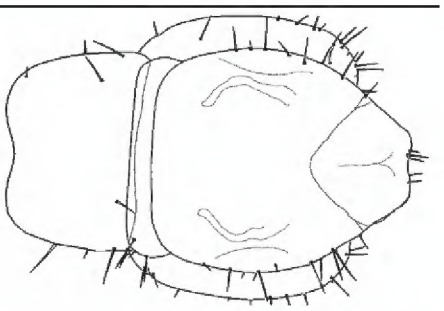
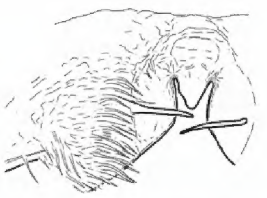
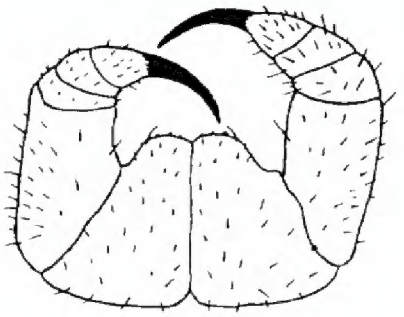
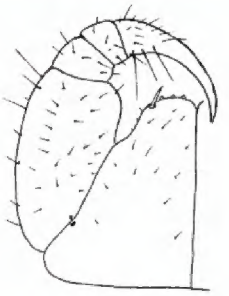
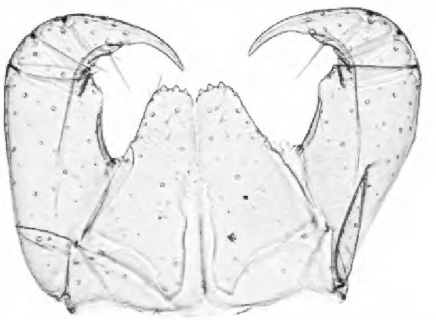
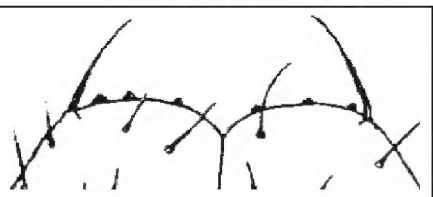
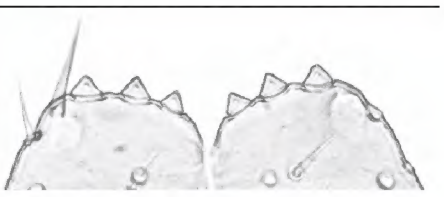
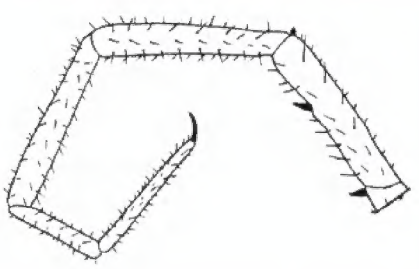
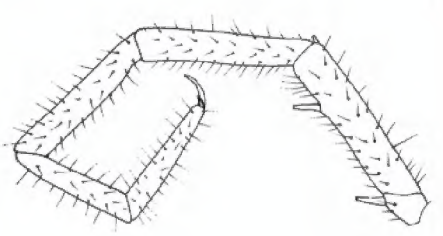
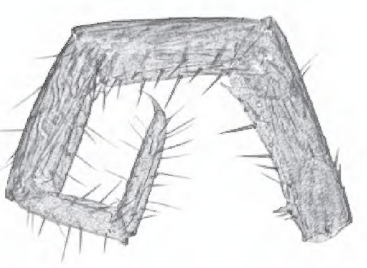


Figure 44. *Shikokuobius japonicus* (Murakami, 1967), DNA voucher specimen of Edgecombe and Giribet (2003, 2004), labrum, ventral view. Scale bar: 0.01 mm (courtesy of G.D. Edgecombe).

Figure 45. Habitat of *Shikokuobius altaicus* sp. n. (♀, PSU-612) in the Tigirek State Nature Reserve (courtesy of T.M. Krugova).

Table 1. The main differences between *S. japonicus* (Murakami, 1967) and *S. altaicus* sp. n.

	***S. japonicus* (Murakami, 1967)**		***S. altaicus* sp. n.**
	***sensu* Murakami 1967**	***sensu* Shinohara 1982**	
front body part			
	cephalic plate equal in width and length; posterior margin of T1 straight		cephalic plate slightly elongate, width/length ratio 0.8; posterior margin of T1 slightly sinuate
number of antennomeres	18	up to 18	15*
labrum		no data	
	sides are smooth; pair of setae projecting across the labral midpiece absent**		sides with poorly-expressed fringes of bristles; pair of setae projecting across the labral midpiece present
forcipular coxosternite			
	approximately broad, width/length ratio 1.6–1.8:1		narrower, width/length ratio 1.2–1.3:1
dental margin of forcipulae coxosternite			
	teeth very small, separated from each other by distances more than width at the base of a tooth		teeth relatively large, separated from each other by distances less than width at the base of a tooth
leg 15			
	P, F & T elongate and thin		P, F & T shorter and thicker

* antennae in a single male (non-type material) with 17+17 articles

** the apparent absence of a pair of setae projecting across the labral midpiece is likely due to them not being noticed by the author of the original description, but sensu G.D. Edgecombe (previously unpublished SEM image of the DNA voucher specimen of Edgecombe and Giribet (2003, 2004) as in Fig. 44), this pair of setae present.

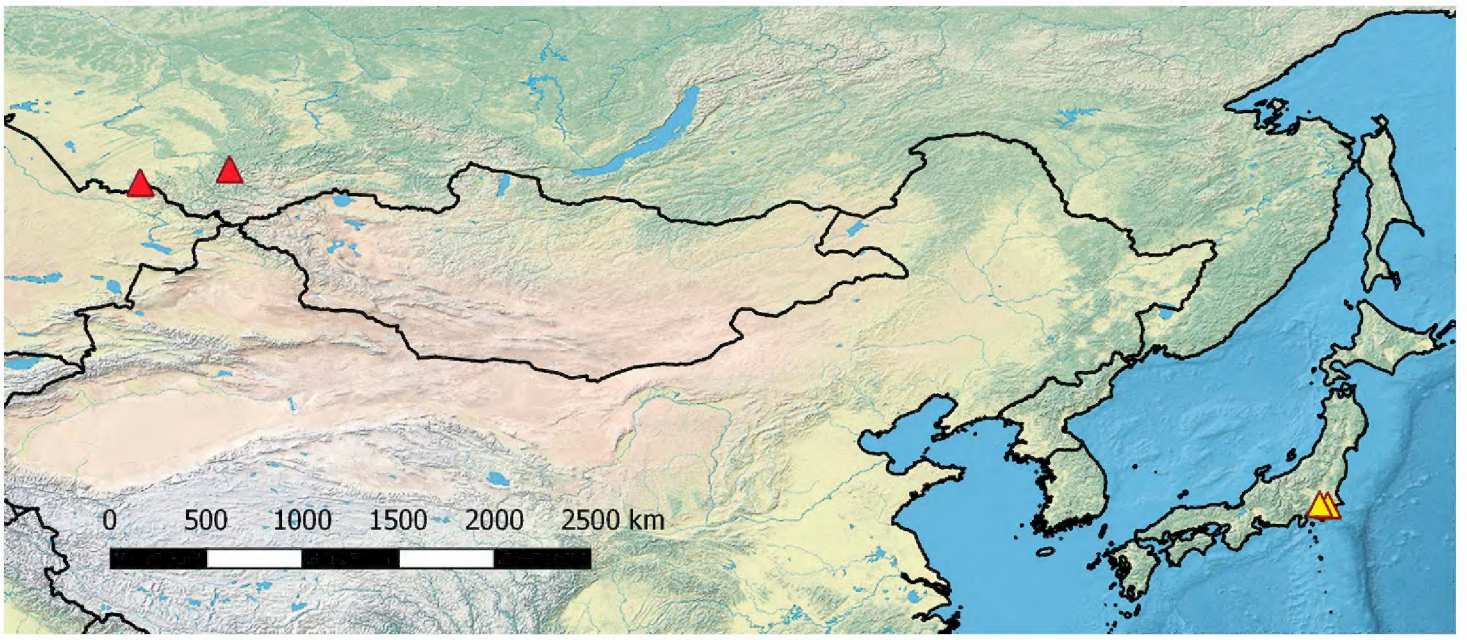


Figure 46. Distribution of *Shikokuobius* species: *altaicus* sp. n. (red triangle) and *japonicus* (Murakami, 1967) (yellow triangle).

Remarks. The new species belongs to the genus *Shikokuobius* Shinohara, 1982 that shows the following synapomorphies: antenna with up to 18 articles, 3+3 coxosternal teeth; spiracles on leg-bearing segments 3, 5, 8, 10, 12 and 14; coxal pores on 12–15 legs; 15 C with a prominent, acute, mesodistal process; 15 t and 15 P with spines, ventrally bifurcated at their tips; at least 15 P with a bifurcate spine at distodorsal end (as some specimens with spines apparently broken off, so these are not visible).

S. altaicus sp. n. is similar to *S. japonicus* (Murakami, 1967), so far the single species in the genus *Shikokuobius*, with the above characters. The main differences between them are given in Table 1. Besides this, the new species differs from *S. japonicus* by: (1) a small distodorsal process on tarsus 2 of legs 13–15 (absent from *S. japonicus*); (2) the number of coxal pores (1,1,1,1(2) in *S. altaicus* sp. n. vs. 2(1),2,2,2 sensu Murakami 1967 and 2,2,2,2(3) sensu Shinohara 1982 in *S. japonicus*).

Finally, *S. altaicus* sp. n. is also rather similar to *Ghilaroviella valiachmedovi* Zalesskaja, 1975, from the Tajikistan in showing the same body length, simple and plumose bristles on the second maxillae; the number of antennomeres, 1–2 coxal pores, 2+2 spurs and a simple ♀ gonopodal claw. However, *S. altaicus* sp. n. is well-distinguished from the latter species by: (1) 3+3 coxosternal teeth (vs. 2+2 in *G. valiachmedovi*); (2) coxal process well-developed only on leg 15 (vs. on legs 14 and 15 in *G. valiachmedovi*) and (3) the absence of small warts at the base of the ♀ gonopodal claw (vs. 2 small warts in *G. valiachmedovi*).

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